Report No. 6216-039
Revision_____

(1)

STRESS ANALYSIS REPORT

FOR THE

MICROWAVE LANDING SYSTEM (MLS)

CLASS V MODIFICATION

C-130 AIRCRAFT

CONTRACT F09603-85-C-1224

CDRL ITEM 0101M

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1.0 SCOPE - This report initiates the documentation and verification of structural modifications, as required for trial kit, proof kit, production, support and management of subsystems collectively designated as the Microwave Landing System (MLS), for use on the C-130 aircraft. Effected types include the C-130E, C-130H, C-130B, WC-130E/H, HC-130H, and HC-130N/P. Upon completion of the trial and proof kitting efforts, this report will be finalized to incorporate any changes resulting from the kit proofing.

Details in this report have been limited to a review of the critical structural elements subjected to identified worst-case loads. Symbols and abbreviations used throughout this report are identified in Table I.

TABLE I. STANDARD SYMBOLS AND ABBREVIATIONS

ABBREV	DEFINITION	UNIT
A	AREA OF CROSS SECTION	IN^2
b	WIDTH OF SECTION	IN
c	DISTANCE FROM NUETRAL AXIS TO EXTREME FIBER	IN
e	ELONGATION (%)	IN/IN
e	DISTANCE FROM HOLE CENTER TO EDGE OF SHEET	IN
e/D	RATIO OF EDGE DISTANCE TO DIAMETER	
D	DIAMETER	IN
d	MOMENT ARM	IN
F	FORCE	LB
F_{bru}	ULTIMATE BEARING STRESS	PSI
F_{bry}	BEARING YIELD STRESS	PSI
F_{ey}	COMPRESSIVE YIELD STRESS	PSI
F_{su}	ULTIMATE SHEAR STRESS	PSI
F_{tu}	ULTIMATE TENSILE STRESS	PSI
F_{ty}	TENSILE YIELD STRESS	PSI
f_{br}	BEARING STRESS	PSI
f_b	BENDING STRESS	PSI
f_c	COMPRESSIVE STRESS	PSI
f_s	SHEAR STRESS	PSI
f_t	TENSILE STRESS	PSI
f_{st}	TORSIONAL SHEAR STRESS	PSI

TABLE I. STANDARD SYMBOLS AND ABBREVIATIONS (Continued)

ABBREV	DEFINITION	UNIT
G	GRAVITATIONAL FORCE	LB
H	HORIZONTAL DIRECTION	
I_{xx}	AREA MOMENT OF INERTIA ABOUT "X-X" AXIS	IN4
L	LENGTH	IN
PSI	POUNDS PER SQUARE INCH	
M	MOMENT	IN-LB
M_x	BENDING MOMENT TAKEN ABOUT POINT "X"	IN-LB
M.S.	MARGIN OF SAFETY	
P_x	APPLIED LOAD AT POINT "X"	LB
P_c	COUPLE LOAD FROM MOMENT	LB
$\underline{P}$	DISTRIBUTED LOAD	LB
P_{br}	BEARING LOAD	LB
P_{bra}	ALLOWABLE BEARING LOAD	LB
P_s	SHEAR LOAD	LB
P_{sa}	ALLOWABLE SHEAR LOAD	LB
P_t	TENSION LOAD	LB
P_{ta}	ALLOWABLE TENSION LOAD	LB
p	SHEAR FLOW	LB/IN
q_a	ALLOWABLE SHEAR FLOW	LB/IN
R	REACTION LOAD	LB

TABLE I. STANDARD SYMBOLS AND ABBREVIATIONS (Continued)

ABBREV	DEFINITION	UNIT
R_{bxx}	BENDING STRESS RATION ABOUT "X-X" AXIS = F_b/F_{tu}	
R_s	SHEAR STRESS RATIO = f_s/F_{su}	
R_t	TENSILE STRESS RATIO = f_t/F_{tu}	
R_{st}	TORSIONAL STRESS RATIO = F_{st}/F_{su}	
r	RADIUS	IN
t	THICKNESS	IN
V	VERTICAL DIRECTION	
y	DISTANCE FROM BASE TO NEUTRAL AXIS	IN
	RADIUS OF GYRATION = $\sqrt{I/A}$	IN
	DENSITY	LB/IN^3
	DEFLECTION	IN

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2.0 STRUCTURAL LOADING CRITERIA

2.1 LIMIT LOAD FACTORS - The mounting structure and installation will be designed to withstand the limit load factors shown in the first column of table II, in both operating and non-operating conditions. Limit loads are the maximum loads the aircraft is expected to encounter at any time in service. All equipment in crew occupied areas will be designed to the limit load factors shown in the second column of table II.

TABLE II. LIMIT LOAD FACTORS

ORIENTATION OF LOAD VECTORS	EQUIPMENT LOCATIONS	
	UNOCCUPIED AREAS	CREW OCCUPIED AREAS
FORWARD	2.0 WITH 5.5 DOWN	16.0
AFT	2.0 WITH 5.5 DOWN	1.5
UP	3.67	4.0
DOWN	5.50	8.0
LATERAL	+/- 2.0	+/- 4.0

2.2 YIELD LOAD FACTORS - Yield loads are 1.15 times the limit load factors stated in paragraph 2.1 above. Application of yield loads to mounting structure and installation will not result in permanent bending or distortion.

2.3 ULTIMATE LOAD FACTORS - Ultimate loads are 1.5 times the limit loads stated in paragraph 2.1 above. Application of ultimate loads to mounting structure and installations may result in permanent bending or distortion. However, there will be no failure of attaching points and equipment will remain in place.

2.4 LOAD APPLICATION CRITERIA - Limit loads applicable to unoccupied areas of the aircraft may be applied independently or in combination, as necessary to create the most severe loading. Exceptions to this are the stated combinations of forward/aft loads combined with down loads , which will not be summed a second time. All other combinations are valid.

Limit loads applicable to crew occupied areas will be applied independently as stated in paragraph 3.1.18 of SPEC 84-MMSRE-009-C-130, REVISION J. (The limit loads for crew occupied areas are in excess of those specified in Ammendment 3 of MIL-A-008865A).

3.0 SUMMARY OF MINIMUM MARGINS OF SAFETY - The analysis shows that all areas of this installation exhibit a positive margin of safety under the design loading conditions specified in section 2.0 and, consequently, shows verification of both the electronic equipment installation and the aircraft structural rework.

Although items listed in the table below exhibit a positive margin of safety, we feel it is necessary to identify margins of safety of less than +0.25 for areas of potential concern for future modifications

PART NAME	TYPE LOADING	PAGE NO.	M.S
No Margins of Safety < +0.25			

4.0 ANALYSIS

4.1.0 UNOCCUPIED AREAS

4.1.1 RECEIVER INSTALLATION (MODELS C-130E/H, WC-130, HC-130)

TWO (2) RECEIVERS ARE REQUIRED FOR MLS. THESE ARE INSTALLED ON THE CENTER UNDERDECK EQUIPMENT RACK, WHERE THE DOPPLER SYSTEM (ASN-35 / APN-147) WAS REMOVED FROM DURING THE SCNS MOD. SOME AIRCRAFT ALSO HAVE TALAR INSTALLED IN THIS LOCATION; THIS EQUIPMENT IS ALSO REMOVED.

THE RECEIVER AND MOUNT CONFORM TO ARINC 727, AND BOTH ARE 3 MCU SIZE. THE MOUNT IS ATTACHED TO MOUNTING RAILS WHICH ARE THEN ATTACHED TO THE EXISTING EQUIPMENT RACK.

- EQUIPMENT WEIGHT

  RECEIVER : 10 LBS MAX
  MOUNT : 2 LBS

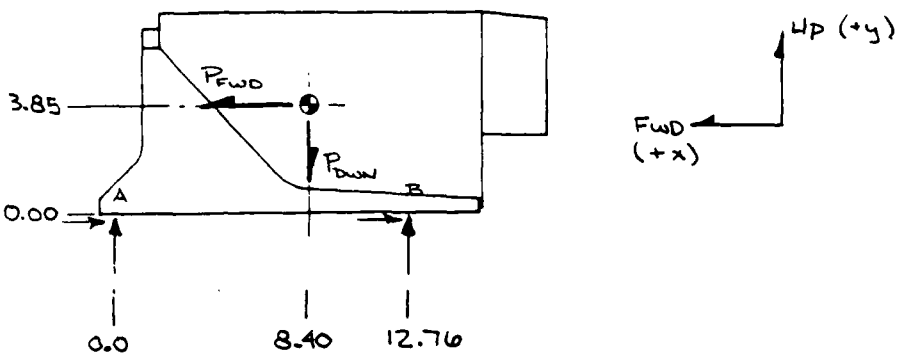
- ULTIMATE LOADS

FWD	(12 LBS)(1.5)(2.0 G)	=	36 LBS ULT
UP	(12 LBS)(1.5)(3.67 G)	=	66 LBS ULT
DWN	(12 LBS)(1.5)(5.5 G)	=	99 LBS ULT
SIDE	(12 LBS)(1.5)(2.0 G)	=	36 LBS ULT

4.1.1 (RECEIVER INSTL)

- ULTIMATE INERTIAL LOADING

FWD: P_{FWD} = 36 LBS W/ 99 LBS DWN



$\Sigma F_y = 0 = P_{Ay} - 99 + P_{By}$

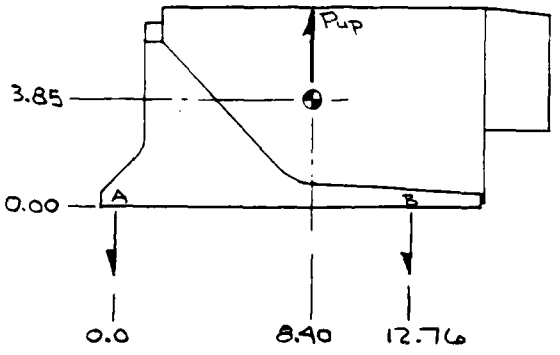
$\Sigma M_A = 0 = 36(3.85) - 99(8.40) + P_{By}(12.76)$

P_{By} = 54.3 LBS (C)

P_{Ay} = 44.7 LBS (C)

P_S = 36 LBS (CARRIED EQUALLY BY 4 SCREWS)

UP: P_{UP} = 66 LBS ULT



$\Sigma M_A = 0 = 66(8.40) - P_{By}(12.76)$

P_{By} = 43.4 LBS (T)

P_{Ay} = 22.6 LBS (T)

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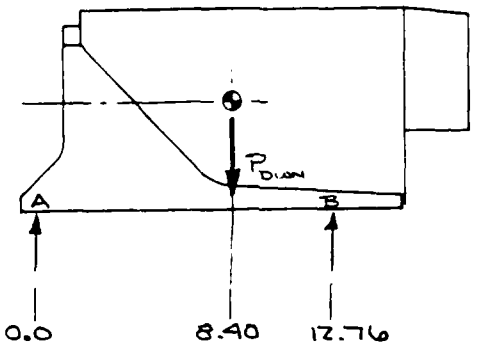
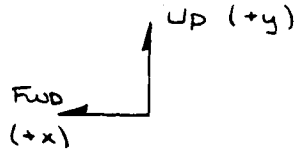
4.1.1 (RECEIVER INSTL)

DOWN: $P_{DOWN} = 99$ LBS ULT





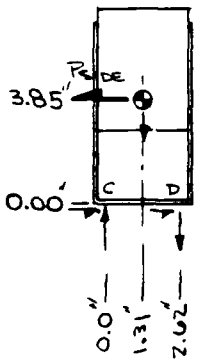
$\Sigma F_y = 0 = P_{Ay} - 99 + P_{By}$

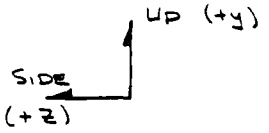
$\Sigma M_A = 0 = 99(8.40) - P_{By}(12.76)$

$P_{By} = 65.2$ LBS (C)

$P_{Ay} = 33.8$ LBS (C)

SIDE: $P_{SIDE} = 36$ LBS ULT





$\Sigma F_y = 0 = P_{Cy} - 12 - P_{Dy}$

$\Sigma M_A = 0 = 36(3.85) - 12(1.31) - P_{Dy}(2.62)$

$P_{Dy} = 47.0$ LBS (T)

$P_{Cy} = 59.0$ LBS (C)

$R = 36$ LBS (DISTRIBUTED EQUALLY AMONG 4 SCREWS)

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4.1.1 (RECEIVER INSTL)

- CHECK SCREWS HOLDING TRAY TO MOUNTING RAILS

SCREWS = NAS517-3 (2 REQ'D / TRAY)
NAS623-3 (2 REQ'D / TRAY)

$P_{TA} = 2490$ LBS
$P_{SA} = 1484$ LBS

WORST CASE LOADING

TENSION $P_T = 47.0$ LBS (SIDE LOAD)
SHEAR $P_S = 36.0$ LBS

FOR WORST CASE, ASSUME ONLY 50% OF FASTENERS DO WORK (1 IN TENSION, 2 IN SHEAR).

TENSION: $R_T = \frac{47 \text{ LBS}}{(2490 \text{ LBS})(1 \text{ SCREW})} = .0189$

SHEAR: $R_S = \frac{36.0 \text{ LBS}}{(1484 \text{ LBS})(2 \text{ SCREWS})} = .0121$

$$MS = \frac{1}{\left[(.0189)^2 + (.0121)^2\right]^{\frac{1}{2}}} - 1$$

MS = + VERY HIGH

4.1.1 (RECEIVER INSTL)

- CHECK MOUNTING RAILS IN BENDING

RAILS: AND10134-1406 (IAW DWG 408753)
AND10136-2401 (IAW DWG 408752)

MAT'L: 2024-T3511
F_{TU} = 57 KSI (MIL-HDBK-5D)

MOMENTS OF INERTIA:

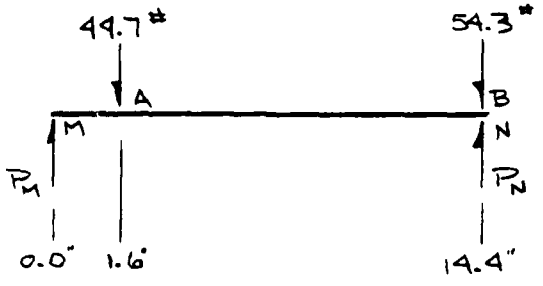
THE COMPLEX AREA MOMENTS OF INERTIA FOR THE MODIFIED SECTIONS ARE CALCULATED ON THE NEXT TWO PAGES.

THE T-SECTION HAS A SLIGHTLY HIGHER MOMENT OF INERTIA BUT SUPPORTS TWO RECEIVERS. THE L-SECTION HAS A LOWER I-VALUE. BOTH WILL BE ANALYZED UNDER WORST-CASE LOADING.

THE FWD END OF RECEIVER FACES AFT IN THE AIRCRAFT. THIS MOUNTING POINT ("B") IS LOCATED DIRECTLY OVER THE RACK AND THUS WILL NOT CAUSE BENDING IN THE SUPPORT RAIL. WORST-CASE LOADING IS THEN CAUSED BY WORST CASE LOADING AT POINT "A".

T-SECTION WORST CASE = FORWARD LOADING

T SUPPORTS $\frac{1}{2}$ LOAD OF TWO RECEIVERS
THUS P_{fwd} = 49.7 LBS



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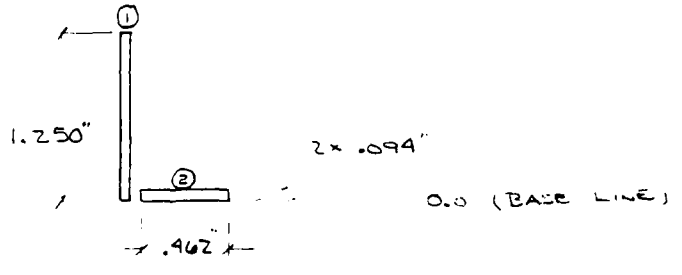
Complex Section Area Moment of Inertia

Section No.	Width (W)	Depth (D)	Area W x D (A)	Distance, C.L. Section to Base (Y)	A x Y	Distance, N.A. to Section C.L. (k)	A x k^2	$WD^3/12$ (I_o)
1	.094	1.250	.118	.625	.074	.155	.0028	.0153
2	.462	.094	.043	.047	.002	.423	.0077	.00003
Total			.161		.076		.0105	.0153
Neutral Axis (N.A. = $\Sigma AY/\Sigma A$): $\frac{.076}{.161} = .470$					Area Moment of Inertia about Centroid of Complex Section $I_t = \Sigma Ak^2 + \Sigma I_o$			.0258

"L" SECTION:



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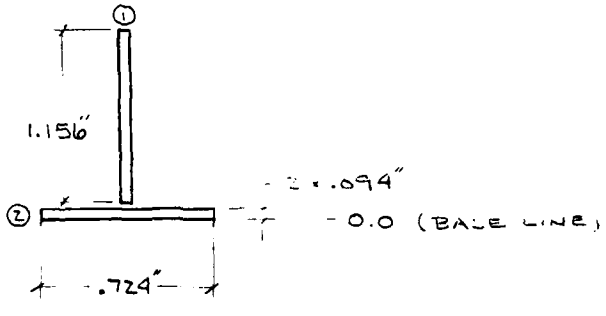
Complex Section Area Moment of Inertia

Section No.	Width (W)	Depth (D)	Area W x D (A)	Distance, C.L. Section to Base (Y)	A x Y	Distance, N.A. to Section C.L. (k)	A x k^2	$WD^3/12$ (I_o)
1	.094	1.156	.1087	.672	.0730	.241	.0063	.0121
2	.724	.094	.0681	.047	.0032	.384	.0100	.00005
Total			.1768		.0762		.0163	.0122
Neutral Axis (N.A. = $\Sigma AY/\Sigma A$): $\frac{.0762}{.1768} = .4310$					Area Moment of Inertia about Centroid of Complex Section $I_t = \Sigma Ak^2 + \Sigma I_o$			.0285

"T" SECTION:



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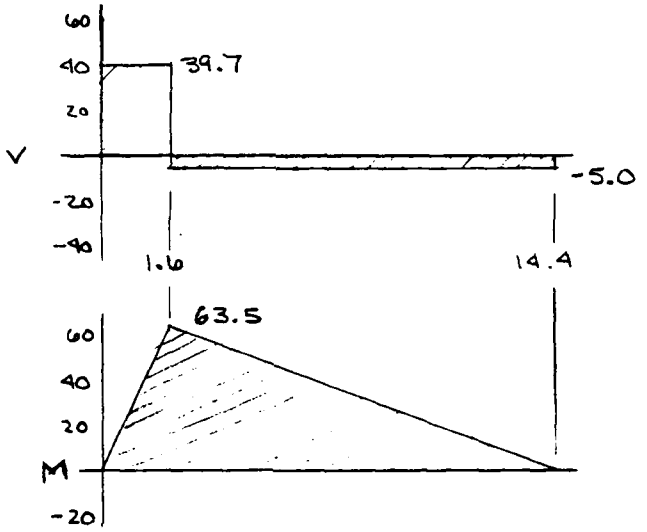
4.1.1 (RECEIVER INSTL)

$$\Sigma F_y = 0 = P_M - 44.3 + P_N - 54.7$$
$$\Sigma M_M = 0 = 44.7(1.6) + 54.3(14.4) - P_N(14.4)$$

$$P_N = 59.3 \text{ LBS}$$
$$P_M = 39.7 \text{ LBS}$$

DETERMINE MAX. MOMENT



TENSILE STRESS FROM BENDING

$$F_b = \frac{MC}{I} = \frac{(63.5 \text{ in-lb})(.431)}{.0285}$$

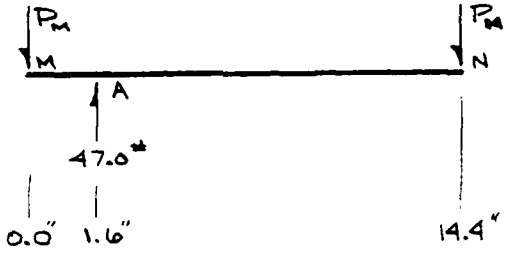
$$F_b = 961 \text{ psi}$$

$$MS = \frac{57000}{961} - 1 \Rightarrow \underline{+ \text{ VERY HIGH}}$$

4.1.1 (RECEIVER INSTL)

L-SECTION WORST CASE = SIDE LOADING

IN SIDE-LOADING SECTION SUPPORTS UPWARD FORCE; ASSUME TOTAL LOAD IS CONCENTRATED AT POINT "A"; THIS WILL GIVE VERY CONSERVATIVE RESULTS.



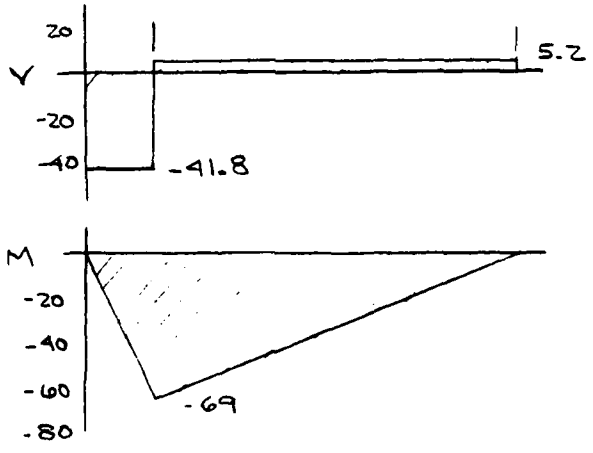
$\Sigma F_y = 0 = P_M - 47 + P_N$

$\Sigma M_M = 0 = 47(1.6) - P_N(14.4)$

$P_N = 5.2$ LBS

$P_M = 41.8$ LBS

DETERMINE MAX. MOMENT



TENSILE STRESS FROM BENDING

$$F_b = \frac{(69\ in\cdot lb)(.47\ in)}{.0258\ in^4} \qquad F_b = 1257\ psi$$

$$MS = \frac{57000}{1257} - 1 \Rightarrow \underline{+VERY\ HIGH}$$

4.1.1 (RECEIVER INSTL)

- CHECK SCREWS HOLDING MTG RAILS TO EQUIPMENT RACK

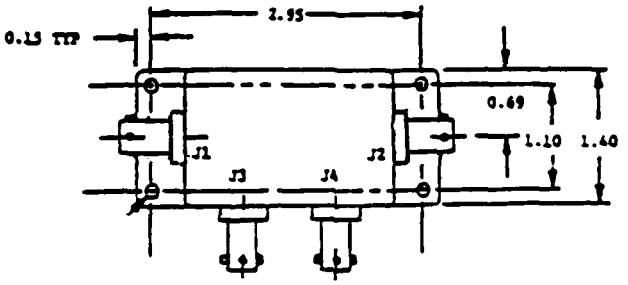
SCREWS ≡ NAS517-3 (2 REQ'D)
NAS623-3 (2 REQ'D)

FROM THE ANALYSIS OF MOUNTING RAILS IN BENDING, IT IS SHOWN THAT THE REACTIONS AT THESE POINTS ARE EQUAL TO OR LESS SEVERE THAN THOSE AT THE TRAY MOUNTING LOCATIONS. HOWEVER, THE SCREWS ARE OF EQUAL STRENGTH. THEREFORE

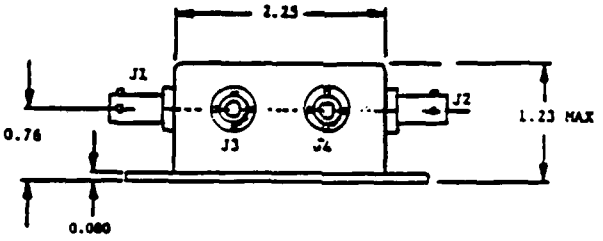
MS ⇒ + VERY HIGH

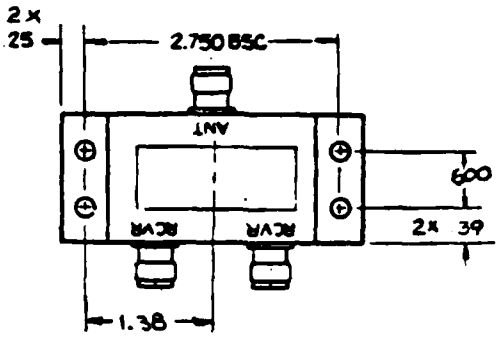
4.1.2 DATA BUS COUPLER / SIGNAL SPLITTER MOUNTING

TWO (2) DATA BUS COUPLERS AND TWO (2) ANTENNA SIGNAL SPLITTERS ARE REQUIRED FOR THE MLS MOD. THESE ARE INSTALLED ON THE CENTER UNDERDECK RACK, NEXT TO THE RECEIVERS. THE SKETCHES BELOW ILLUSTRATE THE BASIC DIMENSIONS OF THE TWO UNITS. ASSUME THE C.G. IS LOCATED AT GEOMETRIC CENTER.

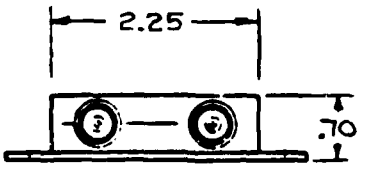


DATA BUS COUPLER





SIGNAL SPLITTER



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4.1.2 (DATA BUS CPLR/SIGNAL SPLITTER)

THE DATA BUS COUPLERS AND SIGNAL SPLITTERS ARE ATTATCHED TO A MOUNTING ANGLE (DWG 408754). THIS ANGLE IS THEN INSTALLED ON THE EQUIPMENT RACK.

THE FOLLOWING WILL BE ANALYZED UNDER WORST-CASE CONDITIONS:

- FASTENERS ATTACHING DATA BUS COUPLERS TO MOUNT
- FASTENERS ATTACHING SIGNAL SPLITTERS TO MOUNT
- FASTENERS ATTACHING MOUNT TO EQUIPMENT RACK
- MOUNT BENDING DUE TO COUPLERS (VERTICAL FLANGE)
- MOUNT BENDING DUE TO TOTAL LOADING

- EQUIPMENT WEIGHT

  DATA BUS COUPLER : .35 LBS MAX
  SIGNAL SPLITTER : .25 LBS

- ULTIMATE LOADS

  DATA BUS COUPLER:

FWD	(.35 LB)(1.5)(2.0 G)	=	1.1 LBS ULT
UP	(.35 LB)(1.5)(3.67 G)	=	2.0 LBS ULT
DWN	(.35 LB)(1.5)(5.5 G)	=	2.9 LBS ULT
SIDE	(.35 LB)(1.5)(2.0 G)	=	1.1 LBS ULT

  SIGNAL SPLITTER:

FWD	(.25 LB)(1.5)(2.0 G)	=	0.8 LBS ULT
UP	(.25 LB)(1.5)(3.67G)	=	1.4 LBS ULT
DWN	(.25 LB)(1.5)(5.5 G)	=	2.1 LBS ULT
SIDE	(.25 LB)(1.5)(2.0 G)	=	0.8 LBS ULT

4.1.2 (DATA BUS CPLR/SIGNAL SPLITTER)

- ADDITIONAL LOADS

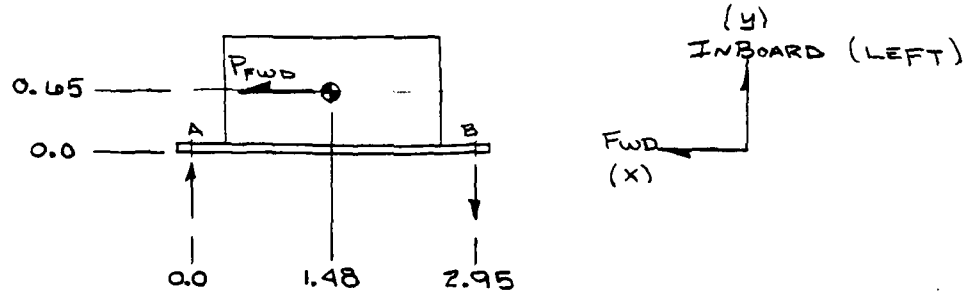
THE ATTACHED CABLES EXERT FORCE ON THE COUPLERS AND SPLITTERS. CONSIDER THESE AS ADDITIONAL LOADS, APPROXIMATELY EQUAL TO TWICE THE DOWNWARD BODY LOAD:

COUPLER CABLE LOAD = 5.8 LBS
SPLITTER CABLE LOAD = 4.2 LBS

- ULTIMATE INERTIAL LOADS - DATA BUS COUPLERS

THE TWO COUPLERS ARE MOUNTED VERTICALLY, AS SHOWN.

FORWARD $P_{FWD} = 6.9$ LBS



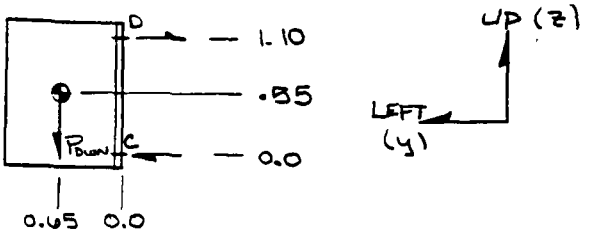
$\Sigma F_y = 0 = P_{Ay} - P_{By}$
$\Sigma M_A = 0 = 6.9(.65) - P_{By}(2.95)$

$P_{By} = 1.5$ LBS (T)
$P_{Ay} = 1.5$ LBS (C)

$P_S = 6.9$ LBS (CARRIED EQUALLY BY 4 SCREWS)

4.1.2 (DATA BUS CPLR/ SIGNAL SPLITTER)

DOWN $P_{DWN} = 8.7$ LBS



$\Sigma F_y = 0 \cdot P_{Cy} - P_{Dy}$

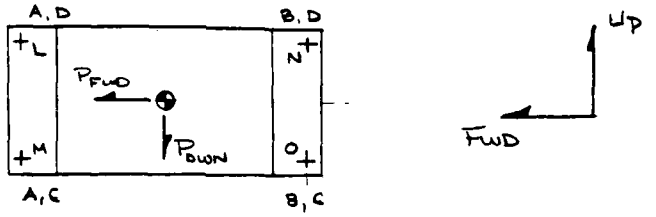
$\Sigma M_C = 0 = 8.7(.65) - P_{Dy}(1.10)$

$P_{Dy} = 5.1$ LBS (T)

$P_{Cy} = 5.1$ LBS (C)

$P_S = 8.7$ LBS (CARRIED BY 4 SCREWS)

COMBINED FORWARD & DOWN LOADING SUMMARY



$P_L = P_A + P_D = -1.5 + 5.1$ $\quad P_L = 3.6$ LBS (T)

$P_M = P_A + P_C = -1.5 - 5.1$ $\quad P_M = 6.6$ LBS (C)

$P_N = P_B + P_D = 1.5 + 5.1$ $\quad P_N = 6.6$ LBS (T)

$P_O = P_B + P_C = 1.5 - 5.1$ $\quad P_O = 3.6$ LBS (C)

$P_S = [(6.9)^2 + (8.7)^2]^{1/2}$ $\quad P_S = 11.1$ LBS (CARRIED BY 4 SCREWS)

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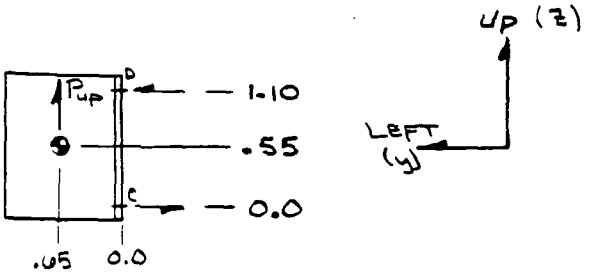
4.1.2 (DATA BUS CPLR / SIGNAL SPLITTER)

SIDE $P_{SIDE} = 6.9$ LBS

SINCE C.G. IS EQUALLY DISTANT FROM ALL MOUNTING POINTS, SIDE-LOADING IS EQUALLY DISTRIBUTED AMONG 4 SCREWS. THEREFORE:

$P_T \cong 1.7$ LBS / SCREW

UP $P_{UP} = 7.8$ LBS



$\Sigma F_y = 0 = P_{Dy} - P_{Cy}$

$\Sigma M_C = 0 = 7.8(.65) - P_{Dy}(1.10)$

$P_{Dy} = 4.6$ LBS (C)

$P_{Cy} = 4.6$ LBS (T)

$P_R = 7.8$ LBS (CARRIED BY 4 SCREWS)

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4.1.2 (DATA BUS CPLR / SIGNAL SPLITTER)

- CHECK SCREWS ATTACHING DATA BUS COUPLERS TO MOUNT

SCREWS = MS51957-28 (4 REQD)

P_{TA} = 730 LBS
P_{SA} = 487 LBS

THE MAXIMUM TENSILE LOAD ON ANY ONE FASTENER IS 6.6 LBS, AND THE MAXIMUM SHEAR IS 11.1 LBS - BOTH FROM COMBINED FWD & DOWN LOADING. THESE ARE VERY SMALL LOADS COMPARED TO THE CAPACITY OF THE SCREWS. THEREFORE:

MS ⇒ + HIGH

- CHECK SCREWS ATTACHING SIGNAL SPLITTERS TO MOUNT

THE ANTENNA SIGNAL SPLITTERS ARE SIMILIAR IN SHAPE AND MOUNTING STYLE TO THE DATA BUS COUPLERS; HOWEVER, THEY HAVE A LOWER WEIGHT AND C.G., AND THEREFORE THE LOADING ON THE FASTENERS WILL BE LESS. SINCE THE SCREWS USED (NAS623-3) ARE HIGHER STRENGTH THAN THE MS51957-28 USED ABOVE NO FURTHER ANALYSIS NEED BE DONE. THEREFORE

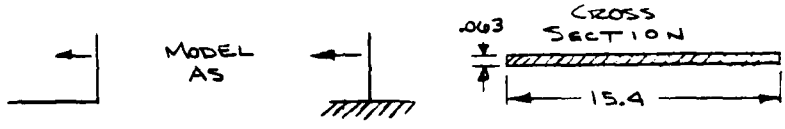
MS. ⇒ + HIGH

4.1.2 (DATA BUS CPLR / SIGNAL SPLITTER)

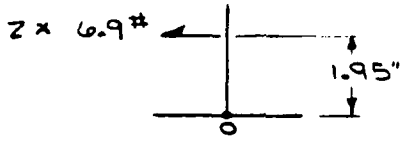
- CHECK VERTICAL LEG OF MOUNTING ANGLE AGAINST BENDING CAUSED BY DATA BUS COUPLERS

ANGLE: MAT'L 2024-T3 AL ALY IAW QQ-A-250/4
.063 STK

$F_{TU} = 64$ KSI



WORST-CASE LOADING = SIDE



$M_a = 27.0$ in-lbs

$I = \frac{1}{12}bh^3 = \frac{1}{12}(15.4)(.063)^3$ $\quad I = 3.21 \times 10^{-4}$ in^4

$F_b = \frac{My}{I} = \frac{(27)(.03)}{3.21 \times 10^{-4}}$ $\quad F_b = 2523$ PSI

$M.S. = \frac{64000}{2523} - 1 \Rightarrow$ + HIGH

4.1.2 (DATA BUS CPLR / SIGNAL SPLITTER)

- CHECK MOUNTING ANGLE IN BENDING

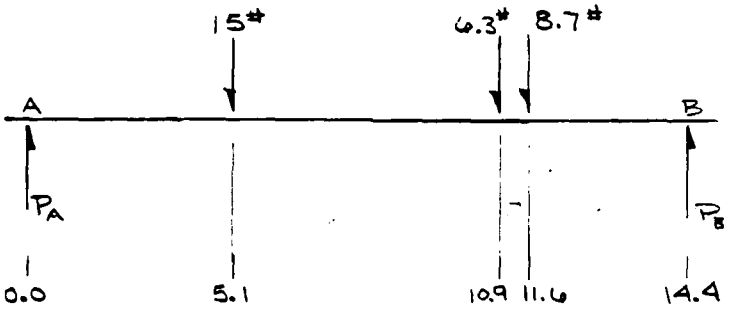
WORST CASE LOADING = DOWN

COUPLER LOAD	8.7 LBS / UNIT
SPLITTER LOAD	6.3 LBS / UNIT

THE COMPLEX AREA MOMENT OF INERTIA IS CALCULATED ON THE FOLLOWING PAGE.

$$I = .3680 \text{ in}^4$$

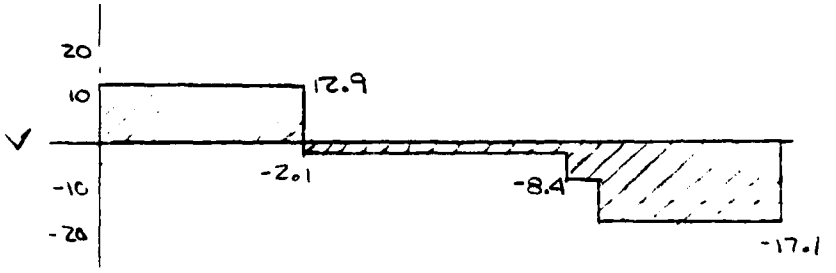
DETERMINE REACTIONS



$$\Sigma M_A = 0 = 15(5.1) + 6.3(10.9) + 8.7(11.6) - P_B(14.4)$$
$$\Sigma F_y = 0 = P_A - 15 - 6.3 - 8.7 + P_B$$

$$P_B = 17.1 \text{ LBS}$$
$$P_A = 12.9 \text{ LBS}$$

DETERMINE MAX MOMENT



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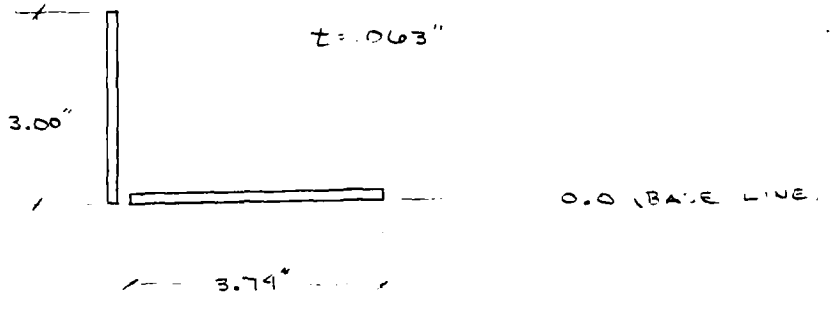
Report No. 6216-039
Revision_____

Complex Section Area Moment of Inertia

Section No.	Width (W)	Depth (D)	Area W x D (A)	Distance, C.L. Section to Base (Y)	A x Y	Distance, N.A. to Section C.L. (k)	A x k^2	$WD^3/12$ (I_o)
1	.063	3.0	.1890	1.500	.2835	.8149	.1255	.1418
2	3.74	.063	.2356	.0315	.0074	.6536	.1006	.0001
Total			.4246		.2909		.2261	.1419
Neutral Axis (N.A. = $\Sigma AY/\Sigma A$): $\frac{.2909}{.4246} = .6851$					Area Moment of Inertia about Centroid of Complex Section $I_t = \Sigma Ak^2 + \Sigma I_o$			.2638

MOUNTING ANGLE:



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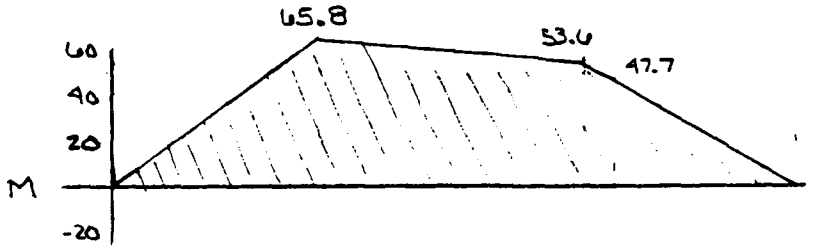
4.1.2 (DATA BUS CPLR / SIGNAL SPLITTER)



$\therefore$ $M_{MAX} = 66$ IN·LBS

DETERMINE BENDING STRESS

$$F_B = \frac{My}{I} = \frac{(66)(.6851)}{.3680}$$

$F_B = 123$ psi

$$MS = \frac{64000}{123} - 1 \Rightarrow \text{+ VERY HIGH}$$

- CHECK SCREWS HOLDING MOUNT TO EQUIPMENT RACK

SCREWS NAS 623-3 (4 REQD)

$P_{TA} = 2490$ LBS
$P_{SA} = 1484$ LBS

THE LOADS HERE ARE MINIMAL FOR THESE SCREWS THEREFORE

MS $\Rightarrow$ + HIGH

4.1.3 RECEIVER/DATA BUS COUPLER INSTALLATION - Model C-130B

Analysis not complete on these installations. Preliminary analysis indicates that all Margins of Safety are positive and >0.25.

4.1.4 SIGNAL SPLITTER/RELAY INSTALLATION - Model C-130B

Analysis not complete on these installations. Preliminary analysis indicates that all Margins of Safety are positive and >0.25.

4.1.5 FRONT ANTENNA INSTALLATION

TWO (2) MLS ANTENNAS (SIMILIAR TO ARINC 727 MOUNTING STYLE "B") ARE MOUNTED INSIDE THE RADOME, ON THE FS 93 BULKHEAD AT APPROX. BL 10.75 (RIGHT & LEFT).

THESE ANTENNAS ARE MOUNTED TO TWO MTG. ANGLES WHICH ARE ATTACHED TO EXISTING STRUCTURE.

- EQUIPMENT WEIGHT

  ANTENNA : 1.2 OZ ≈ .1 LB

  ASSUME MAX WEIGHT OF .4 LB, INCLUDING CONNECTOR, CABLE LOAD, & MTG ANGLE.

- ULTIMATE LOADS

$P_{FWD} = (.4)(1.5)(2.0\,G) = 1.2$ LBS ULT
$P_{UP} = (.4)(1.5)(3.67\,G) = 2.2$ LBS ULT
$P_{DWN} = (.4)(1.5)(5.5\,G) = 3.3$ LBS ULT
$P_{SIDE} = (.4)(1.5)(2.0\,G) = 1.2$ LBS ULT

- WORST CASE LOADING ≡ COMBINED FWD & DOWN

ASSUME THE ANTENNA C.G. IS LOCATED AT THE MOUNTING BASE.

4.1.5 (FRONT ANTENNA INSTL)

- CHECK SCREWS ATTACHING ANTENNA TO MTG ANGLE

SCREWS : NAS 517-3

P_{TA} = 2490 LBS
P_{SA} = 1660 LBS

WORST CASE LOADS :

P_T = 3.3 LBS
P_S = 1.2 LBS

ASSUMING ONLY 50% OF FASTENERS ARE EFFECTIVE. ULTIMATE LOADS ARE STILL MINIMAL COMPARED TO SCREW STRENGTHS. THEREFORE

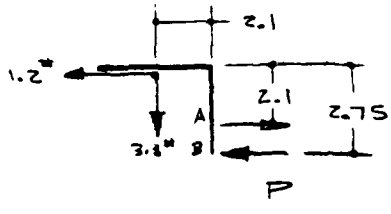
MS = + VERY HIGH

- CHECK SCREWS ATTACHING MTG ANGLE TO AIRCRAFT.

SCREWS NAS623-3

P_{TA} = 2490 LBS
P_{SA} = 1660 LBS

WORST CASE LOAD



$\Sigma F_x = 0 = 1.2 - P_{Ax} + P_{Bx}$

$\Sigma M_A = 0 = 1.2(2.1) + (3.3)(2.1) - P_B(2.75)$

P_B = 3.4 LBS (C)

P_A = 4.6 LBS (T)

SINCE LOADS ARE SO SMALL: P_S = 3.3 LBS

MS ⇒ + VERY HIGH

4.1.5 (FRONT ANTENNA INSTL)

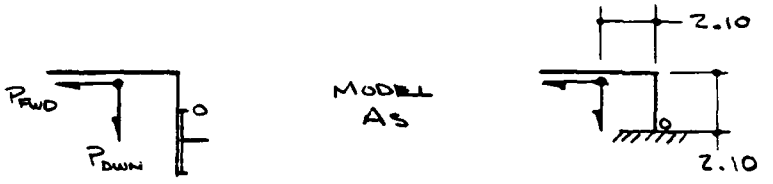
• CHECK MTG ANGLE IN BENDING

MATL: 2024-T3 AL ALY IAW QQ-A-250/4
.080 STK

$F_{TU} = 64$ KSI
$F_{SU} = 39$ KSI

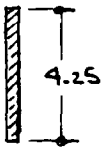
DETERMINE TENSILE STRESS FROM BENDING

WORST CASE MOMENT WILL OCCUR AT TOP TWO FASTENERS



$\Sigma M_o = 1.2(2.1) + 3.3(2.1)$ $\quad \Sigma M_o = 9.5$ IN-LBS

BENDING CROSS SECTION



$I = \frac{1}{12} bh^3 = \frac{1}{12}(4.25)(.080)^3$

$I = .00018$

$F_B = \frac{My}{I} = \frac{(9.5)(.04)}{.00018}$ $\quad F_B = 2112$ PSI

$MS = \frac{64000}{2112} - 1 \Rightarrow$ + VERY HIGH

4.1.6 AFT ANTENNA INSTALLATION

ONE (1) ARINC 727 MOUNTING STYLE "A" ANTENNA WITH INTEGRAL PRE-AMPLIFIER IS MOUNTED ON THE TAIL ACCESS DOOR, FS 1051. A DOUBLER IS PLACED ON THE DOOR TO GIVE ADDED STRENGTH.

- EQUIPMENT WEIGHT

  ANTENNA & PRE-AMP : 0.5 LB (8 OZ) MAX

- ULTIMATE LOADS

$P_{FWD} = (.5)(1.5)(2.0G) = 1.5$ LBS ULT
$P_{UP} = (.5)(1.5)(3.67G) = 2.8$ LBS ULT
$P_{DOWN} = (.5)(1.5)(5.5G) = 4.2$ LBS ULT
$P_{SIDE} = (.5)(1.5)(2.0G) = 1.5$ LBS ULT

- WORST CASE LOADING = COMBINED FWD + DOWN

- CHECK SCREWS ATTACHING ANTENNA TO FUSELAGE

  SCREWS: NAS 517-3 (6 REQD)

  $P_{TA} = 2490$ LBS
  $P_{SA} = 1660$ LBS

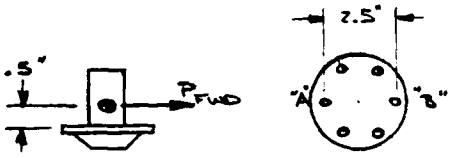
  SCREW TENSION DUE TO DOWN LOAD

  IN WORST CASE ASSUME ONLY 50% OF FASTENERS DO WORK

$$P_T = \frac{4.2}{3} \qquad \underline{P_T = 1.4 \text{ LBS}}$$

4.1.6 (AFT ANTENNA INSTL)

SCREW LOAD DUE TO FWD LOADING



MAX. TENSILE LOAD OCCURS AT PT "B". FOR EASE OF ANALYSIS CONSIDER ONLY SCREWS AT "A" & "B". THIS WILL GIVE CONSERVATIVE RESULTS.

$$\Sigma F_y = 0 = P_A - P_B$$
$$\Sigma M_A = 0 = 1.5(.5) - P_B(2.5)$$

$$P_B = .3 \text{ LBS}$$

ASSUME SHEAR CARRIED BY 3 SCREWS

$$P_S = .5 \text{ LBS}$$

THEREFORE, BECAUSE REACTION FORCES ARE VERY SMALL IN COMPARISON TO SCREW STRENGTHS:

$$MS \Rightarrow + \text{ VERY HIGH}$$

4.1.6 (AFT ANTENNA INSTL)

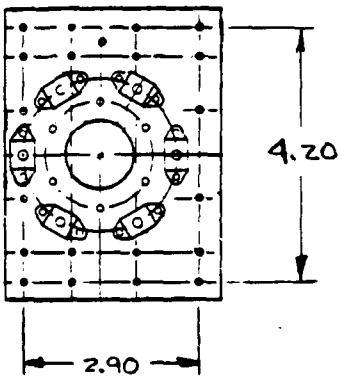
- CHECK SKIN AND DOUBLER SHEAR CAPACITY

DOOR: 7075-T6 .050 STK

$F_{TU} = 72$ KSI
$F_{SU} = 43$ KSI

DOUBLER: 7075-T6 IAW QQ-A-250/12

$F_{TU} = 72$ KSI
$F_{SU} = 43$ KSI



SHEAR LOAD CAPACITY OF MAT'L REMOVED

TO ACCOMODATE ANTENNA, DOOR MATL MUST BE REMOVED IN FORM OF 1.45 Ø HOLE.

AREA LOST = (.050)(1.45) = .073 in²
SHEAR LOST = (.073)(43) = 3.12 lbs = P_{SL}

SHEAR LOAD CAPACITY OF ADDED DOUBLER

AREA ADDED = (.071)(2.9 - 1.45) = .103 in²
SHEAR ADDED = (.103)(43) = 4.43 LBS = P_{SA}

THEREFORE:

$$MS = \frac{4.43}{3.12} - 1 \rightarrow \underline{\underline{+.42}}$$

4.1.6 (AFT ANTENNA INSTL)

- CHECK RIVETS ATTACHING DOUBLER TO SKIN

RIVETS = MS20426AD4-5 (26 REQD)

P_{SA} = 340 LBS / RIVET

IN WORST CASE ASSUME ONLY 50% OF RIVETS DO WORK. SHEAR CAPACITY OF ADDED RIVETS MUST BE GREATER THAN THAT OF MATL REMOVED.

$$M.S. = \frac{340(26/2)}{3120} \Rightarrow \underline{+.42}$$

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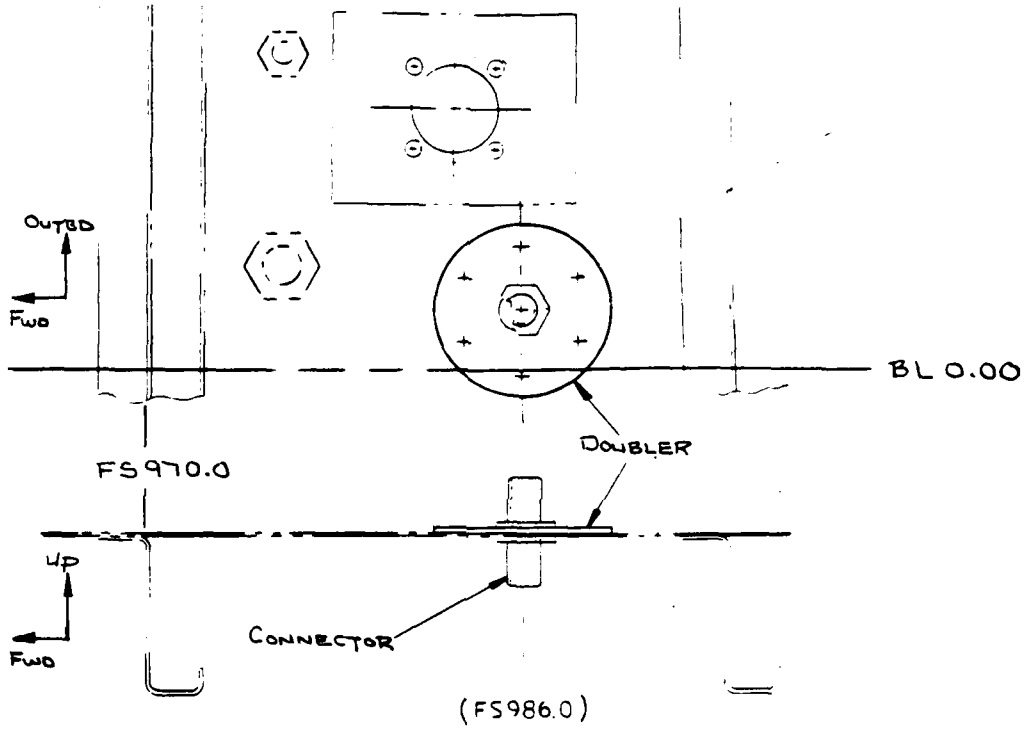
4.1.7 AFT PRESSURE FEED THRU

THE AFT ANTENNA IS MOUNTED IN AN UNPRESSURIZED AREA OF THE TAIL. THE ANTENNA CABLE MUST BE ROUTED THRU A BULKHEAD INTO THE PRESSURIZED CARGO COMPARTMENT. A BULKHEAD FEED-THRU CONNECTOR IS USED, AND A DOUBLER IS ADDED FOR STRENGTH.



- WORST CASE LOADING

THE ADDED DOUBLER IS PLACED HORIZONTALLY ON THE PRESSURIZED SIDE OF THE SKIN. THE MAX LOAD ON THE DOUBLER WILL BE THE PRESSURE DIFFERENTIAL. THEREFORE

$$P_{ULT} = 14.7 \text{ psi}$$

4.1.7 (AFT PRESSURE FEED THRU)

• CHECK SKIN AND DOUBLER SHEAR CAPACITY

SKIN : 2024-T3 IAW QQ-A-250/13 .050 STK

$F_{SU} = 39$ KSI

DOUBLER: 2024-T3 IAW QQ-A-250/4 .050 STK

$F_{SU} = 39$ KSI

SHEAR LOAD CAPACITY OF MATL REMOVED

TO ACCOMODATE THE PRESSURE FEED THRU, SKIN MAT'L MUST BE REMOVED IN THE FORM OF ONE Ø.51 HOLE

AREA LOST = (.050)(.51) = .0255 in^2
SHEAR LOST = (.0255)(39) = .99 KIPS

SHEAR LOAD CAPACITY OF ADDED DOUBLER

AREA ADDED = (1.5-.51)(.050) = .050 in^2
SHEAR ADDED = (.050)(39) = 1.95 KIPS

$$MS = \frac{1.95}{.99} - 1 \Rightarrow \underline{+ .97}$$

• CHECK RIVETS ATTACHING DOUBLER TO AIRCRAFT

RIVETS = MS20470AD4 (6 REQD)

$P_{SA} = 390$ LBS/RIVET

4.1.7 (AFT PRESSURE FEED THRU)

RIVETS MUST HAVE SHEAR CAPACITY GREATER THAN THAT OF MATL REMOVED

$$MS = \frac{(340)(6)}{990} - 1 \Rightarrow \underline{+1.06}$$

- CHECK PRESSURE LOAD ON SKIN AT CONNECTORS

THE PRESSURE DIFFERENTIAL WILL ACT OVER THE AREA OF THE CONNECTOR. ASSUMING THIS AREA TO BE LARGEST AT THE BASE:

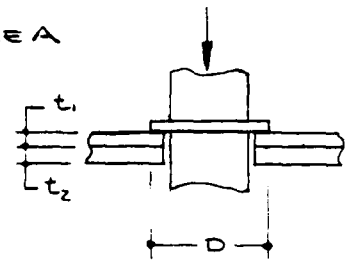
$$A_p \approx \frac{\pi}{4}(.56)^2 \cong .25\ in^2$$

THE MAX LOAD ON THE CONNECTOR DUE TO PRESSURE IS THEN:

$$F_p = (.25)(14.7\ psi) = 3.7\ lbs$$

CALCULATE THE SHEAR AREA

$$A_s = \pi D(t_1 + t_2)$$
$$= \pi(.56)(.032 + .050)$$
$$= .144\ in^2$$



SHEAR STRESS

$$\tau = \frac{3.7}{.144} = 26\ psi$$

$$MS = \frac{39000}{26} - 1 \Rightarrow \underline{+\text{VERY HIGH}}$$

4.2.0 CREW OCCUPIED AREAS

4.2.1 TOP ANTENNA INSTALLATION

ONE (1) ARINC 727 MOUNTING STYLE "B" ANTENNA IS MOUNTED ON THE TOP OF THE AIRCRAFT, AT FS 192, BL 0.0. A DOUBLER IS PLACED AT THIS LOCATION FOR ADDED STRENGTH.

- EQUIPMENT WEIGHT

  ANTENNA: 1.2 oz ≈ .1 LB

  ASSUME MAXIMUM WEIGHT OF .3 LB INCLUDING CONNECTOR & CABLE LOADS.

- ULTIMATE LOADS

$$P_{FWD} = (.3)(1.5)(16\,G) = 7.2 \text{ LBS ULT}$$
$$P_{UP} = (.3)(1.5)(4\,G) = 1.8 \text{ LBS ULT}$$
$$P_{DWN} = (.3)(1.5)(8\,G) = 3.6 \text{ LBS ULT}$$
$$P_{SIDE} = (.3)(1.5)(4\,G) = 1.8 \text{ LBS ULT}$$

ASSUME THE ANTENNA C.G. IS LOCATED AT THE BASE PLATE OF THE ANTENNA.

- CHECK SCREWS ATTACHING ANTENNA TO FUSELAGE

  SCREWS: NAS 517-3 (4 REQ'D)

$$P_{TA} = 2490 \text{ LBS}$$
$$P_{SA} = 1660 \text{ LBS}$$

4.2.1 (Top Antenna Instl)

Worst Case Loading

Tension = Up P_{UP} = 1.8 lbs
Shear = Fwd P_{FWD} = 7.2 lbs

Since Loads Are So Small In Comparison To Screw Strengths

MS = + Very High

• Check Skin & Doubler Shear Capacity

Skin: 7075-T6 .050 stk

F_{TU} = 72 ksi
F_{SU} = 43 ksi

Doubler: 2024-T3 Al Aly Iaw QQ-A-250/4
.063 stk

F_{TU} = 64 ksi
F_{SU} = 39 ksi

Shear Load Capacity of Matl Removed

To Accomodate Antenna, Skin Matl Must Be Removed in Form of 1.00 ϕ Hole.

Area Lost = (1.050)(1.00) = .050 in^2
Shear Lost = (.050)(43) = 2.15 Kips

4.2.1 (TOP ANTENNA INSTL)

SHEAR LOAD CAPACITY OF ADDED DOUBLER

AREA ADDED = (.063)(5.7) = .3591

SHEAR ADDED = (.3591)(39) = 14.0 KIPS

THEREFORE

$$MS = \frac{14.0}{2.15} - 1 \Rightarrow +5.5$$

- CHECK RIVETS ATTACHING DOUBLER TO SKIN

RIVETS: MS20426AD4-5 (26 REQ'D)

P_{SA} = 340 LBS / RIVET

IN WORST CASE ASSUME ONLY 50% OF RIVETS DO WORK. SHEAR CAPACITY OF ADDED RIVETS MUST BE GREATER THAN THAT OF MAT'L REMOVED.

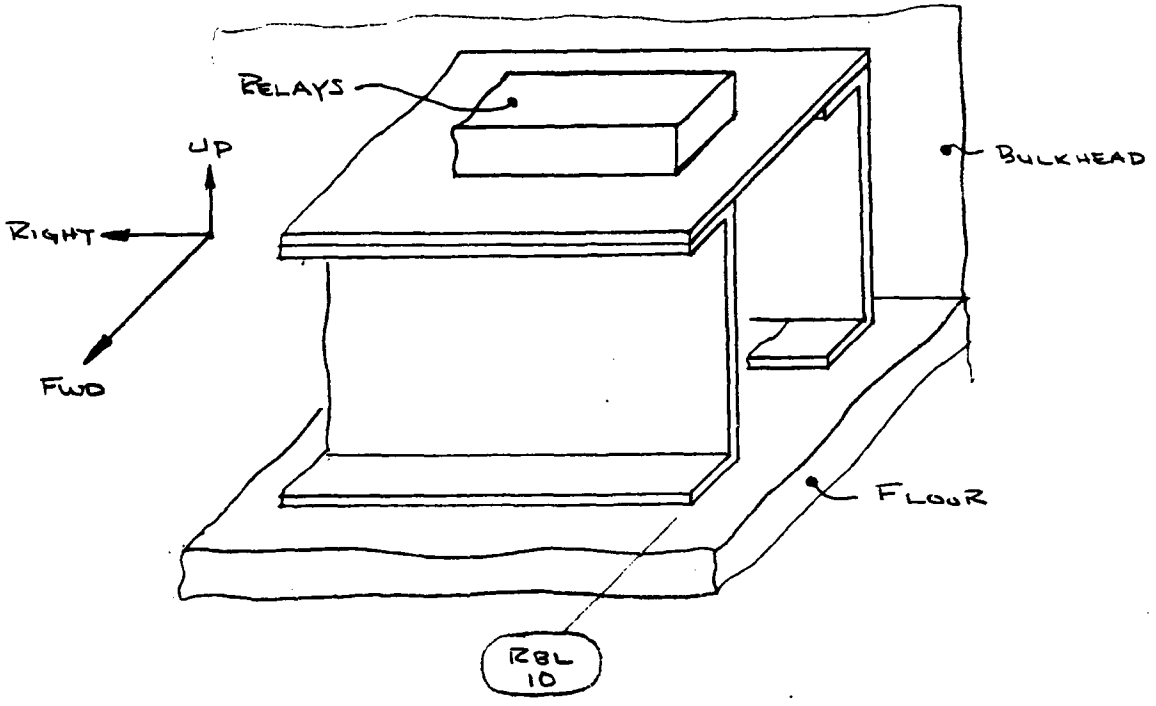
$$MS = \frac{340(13)}{2150} \Rightarrow +1.1$$

4.2.2 Relay Panel Installations

4.2.2.1 Relay Panel - Model C-130E/H/B

On aircraft models C-130E/H/B the MLS Relay Panel is mounted under the bunk, positioned laterally, ahead of the FS245 bulkhead. A maximum of 24 relays can be mounted on the panel.

The Relay Mounting Plate is attached to two (2) channels which are mounted to the aircraft floor structure.



- Equipment Weight

Relays	:	7.0 lbs
Mtg Structure	:	3.0 lbs

4.2.2.1 (RELAY PANEL)

• ULTIMATE LOADS

$P_{FWD} = (10)(1.5)(16\,G) = 240$ LBS ULT
$P_{UP} = (10)(1.5)(4\,G) = 60$ LBS ULT
$P_{DOWN} = (10)(1.5)(8\,G) = 120$ LBS ULT
$P_{SIDE} = (10)(1.5)(4\,G) = 60$ LBS ULT

NOTE: FOR EASE OF ANALYSIS IT IS ASSUMED THAT THE LOADS ACT THRU THE PLANE OF THE MTG. PLATE. THIS RAISES THE C.G. OF THE STRUCTURE SLIGHTLY & WILL GIVE CONSERVATIVE RESULTS.

• CHECK SCREWS ATTACHING MTG PLATE TO CHANNELS

SCREWS = NAS623-2 (8 REQD)

$P_{TA} = 1740$ LBS
$P_{SA} = 1160$ LBS

WORST CASE LOADING = FORWARD

BECAUSE P_{FWD} ACTS THRU PLANE OF PLATE, THESE SCREWS CARRY ONLY SHEAR LOAD.

$P_S = 240$ LBS

FOR WORST CASE ASSUME ONLY 50% OF SCREWS HOLD IN SHEAR

$$MS = \frac{(1160)(4)}{240} \Rightarrow \underline{+\text{ VERY HIGH}}$$

4.2.2.1 (RELAY PANEL)

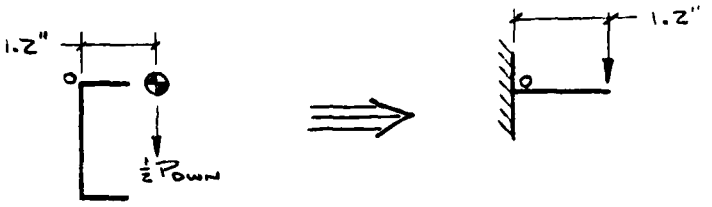
• CHECK TOP FLANGE OF CHANNEL FOR BENDING

MAT'L 6065-T6511 AL ALY EXTRUSION
TIERNAY # 60-2351

F_{TU} = 38 KSI
F_{SU} = 26 KSI

WORST CASE LOADING = DOWN

MODEL FLANGE AS SHOWN, ASSUMING THAT ½ OF LOAD IS CARRIED OVER FLANGE



$M_o = (1.2")(\frac{1}{2})(120)$ M_o = 72 IN·LBS

CALCULATE AREA MOMENT OF INERTIA (I)

$I = \frac{1}{12}bh^3 \cdot \frac{1}{12}(22.5)(.125)^3$ $I = .00366\ in^4$

CALCULATE BENDING STRESS AT "O"

$F_B = \frac{My}{I} = \frac{(72)(.125/2)}{.00366}$ F_B = 1230 psi

$MS \Rightarrow \frac{38000}{1230} - 1 \Rightarrow$ + VERY HIGH

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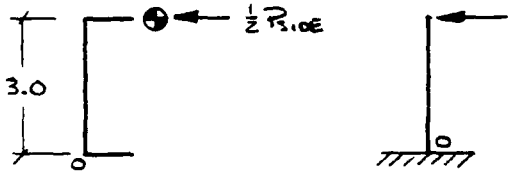
4.2.2.1 (RELAY PANEL)

• CHECK CHANNEL BASE FOR BENDING

WORST CASE LOADING = FORWARD

ASSUME THAT $\frac{1}{2} P_{FWD}$ IS CARRIED BY EACH CHANNEL. MODEL AS SHOWN:



$M_o = (3.0)(.5)(240)$ $\qquad M_o = 360$ IN·LBS

$I = \frac{1}{12} bh^3 = \frac{1}{12}(22.5)(.125)^3$ $\qquad I = .00366$ IN^4

$F_B = \frac{My}{I} = \frac{(360)(.125/2)}{.00366}$ $\qquad F_B = 6148$ PSI

$MS = \frac{38000}{6148} - 1 \Rightarrow +5.2$

• CHECK SCREWS ATTACHING CHANNELS TO AIRCRAFT

SCREWS = NAS623-2 (8 REQD)

$P_{TA} = 1740$ LBS

$P_{SA} = 1160$ LBS

WORST CASE LOADING = FWD

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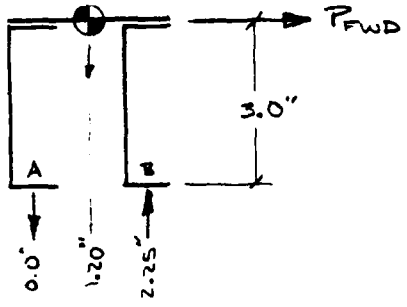
4.2.2.1 (RELAY PANEL)

FWD LOADING $P_{FWD} = 240$ LBS ULT



$$\Sigma F_y = 0 = -P_{Ay} - 10 + P_{By}$$
$$\Sigma M_A = 0 = 240(3) + 10(1.2) - P_{By}(2.25)$$

$$\underline{P_{By} = 325.3 \text{ LBS}} \ (C)$$
$$\underline{P_{Ay} = 315.3 \text{ LBS}} \ (T)$$

ASSUMING 4 HOLD IN TENSION & 4 HOLD IN SHEAR

$$R_T = \frac{315.3}{(4)(1740)} = .045$$

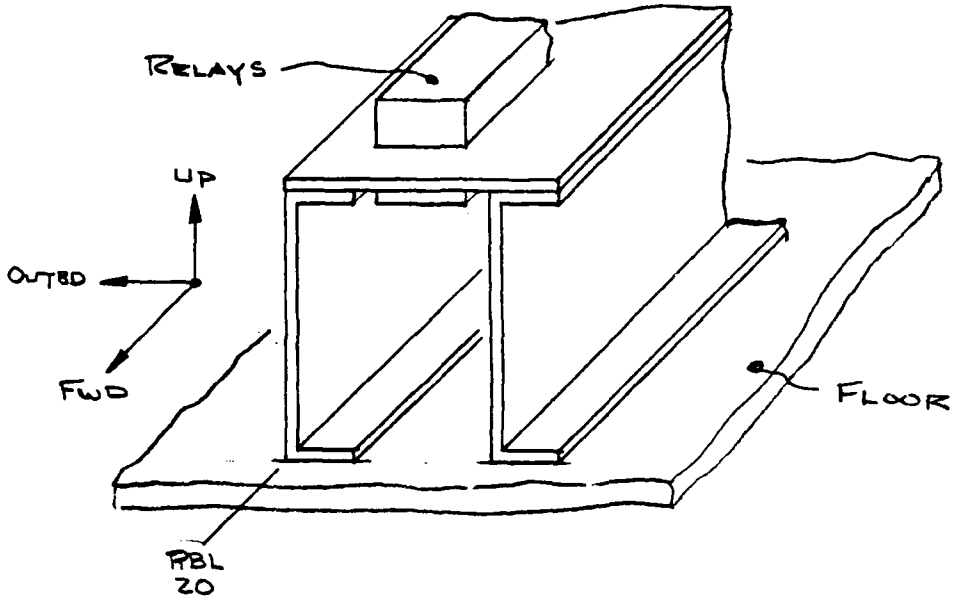
$$R_S = \frac{240}{(4)(1160)} = .052$$

$$MS = \frac{1}{\left[(.045)^2 + (.052)^2\right]^{1/2}} - 1 \Rightarrow \underline{+ \text{ HIGH}}$$

4.2.2.2 RELAY PANEL - MODEL C-130H (LATE)

ON AIRCRAFT MODELS C-130H (LATE) THE RELAY PANEL IS MOUNTED UNDER THE BUNK, POSITIONED FORE - AFT AHEAD OF THE FS 245 BULKHEAD AT APPROXIMATELY RBL 20. A MAXIMUM OF 22 RELAYS CAN BE MOUNTED ON THE PANEL.

THE RELAY MOUNTING PLATE IS ATTACHED TO TWO (2) CHANNELS WHICH ARE MOUNTED TO THE AIRCRAFT FLOOR STRUCTURE.



- EQUIPMENT WEIGHT

RELAYS	:	6.5 LBS
MTG STRUCTURE	:	2.7 LBS

4.2.2.2 (RELAY PANEL)

• ULTIMATE LOADS

$P_{FWD} = (9.2)(1.5)(16\,G) = 221$ LBS ULT
$P_{UP} = (9.2)(1.5)(4\,G) = 55$ LBS ULT
$P_{DWN} = (9.2)(1.5)(8\,G) = 111$ LBS ULT
$P_{SIDE} = (9.2)(1.5)(4\,G) = 55$ LBS ULT

NOTE: FOR EASE OF ANALYSIS IT IS ASSUMED THAT THE LOADS ACT THRU THE PLANE OF THE RELAY MTG PLATE. THIS RAISES THE C.G. OF THE STRUCTURE AND WILL GIVE CONSERVATIVE RESULTS.

• CHECK SCREWS ATTACHING MTG PLATE TO CHANNELS

SCREWS = NAS623-Z (8 REQD)

$P_{TA} = 1740$ LBS (AMDOI 81-1)
$P_{SA} = 1160$ LBS

WORST CASE LOADING = FWD

BECAUSE P_{FWD} ACTS THRU PLATE, THESE SCREWS WILL HAVE ONLY SHEAR LOAD

$P_S = 221$ LBS

FOR WORST CASE ASSUME ONLY 50% OF SCREWS HOLD IN SHEAR

$$MS = \frac{(1160)(4)}{221} \Rightarrow \underline{+ \text{ VERY HIGH}}$$

4.2.2.2 (RELAY PANEL)

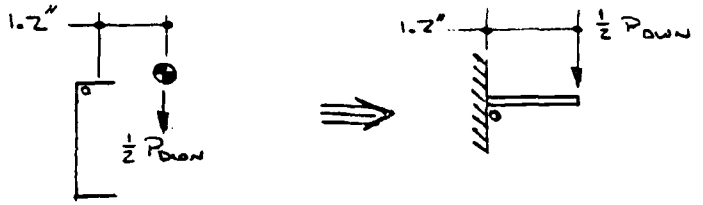
• CHECK TOP FLANGE OF CHANNEL FOR BENDING

MATL: 6061-T6511 AL ALY EXTRUSION
TIERNEY # 60-2351

$F_{TU} = 38$ KSI
$F_{SU} = 26$ KSI

WORST CASE LOADING = DOWN

MODEL FLANGE AS SHOWN, ASSUMING THAT ½ OF LOAD IS CARRIED OVER FLANGE



$M_o = (1.2)(\frac{1}{2})(111)$ $\quad M_o = 67$ IN·LBS

CALCULATE AREA MOMENT OF INERTIA (I)

$I = \frac{1}{12} bh^3 = \frac{1}{12}(20.75)(.125)^3$ $\quad I = .00338$ IN^4

CALCULATE BENDING STRESS

$F_B = \frac{My}{I} = \frac{(67)(.125/2)}{.00338}$ $\quad F_B = 1239$ PSI

$MS = \frac{38000}{1239} - 1 \Rightarrow$ + VERY HIGH

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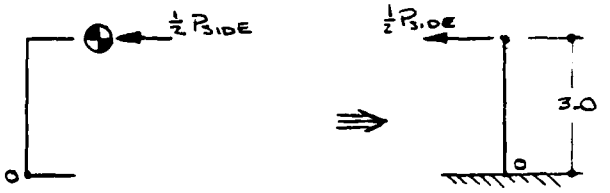
4.2.2.2 (RELAY PANEL)

• CHECK CHANNEL BASE FOR BENDING

WORST CASE LOADING ≡ SIDE

ASSUME THAT ½ SIDE LOADING IS CARRIED BY EACH FLANGE. MODEL AS SHOWN BELOW.



$M_O = (3.0)(.5)(55)$ $\quad M_O = 83$ IN·LBS

$I = \frac{1}{12}bh^3 \cdot \frac{1}{12}(20.75)(.125)^3$ $\quad I = .00338$

$F_B = \frac{My}{I} = \frac{(83)(.125/2)}{.00338}$ $\quad F_B = 1535$ LBS

$MS = \frac{38000}{1535} - 1 \Rightarrow$ + VERY HIGH

• CHECK SCREWS ATTACHING CHANNELS TO AIRCRAFT

SCREWS ≡ NAS 623-2 (8 REQD)

$P_{TA} = 1740$ LBS

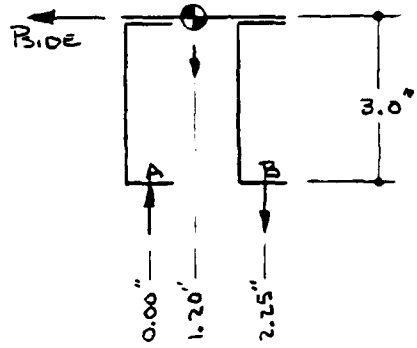
$P_{SA} = 1160$ LBS

WORST CASE LOADING

WORST TENSION CAUSED BY SIDE LOADING
WORST SHEAR CAUSED BY FWD LOADING

4.2.2.2 (RELAY PANEL)

SIDE LOADING $P_{SIDE} = 55$ LBS



$\Sigma F_y = 0 = P_{Ay} - 9.2 - P_{By}$

$\Sigma M_A = 0 = 55(3) - 9.2(1.2) - P_{By}(2.25)$

$P_{By} = 68.5$ LBS (T)

$P_{Ay} = 77.5$ LBS (C)

THEREFORE, ASSUMING 4 HOLD IN TENSION AND 4 HOLD IN SHEAR:

$$R_T = \frac{68.5}{4(1740)} = .010$$

$$R_S = \frac{221}{4(1160)} = .048$$

$$MS = \frac{1}{[(.010)^2 + (.048)^2]^{1/2}} - 1 \Rightarrow \text{+ VERY HIGH}$$

4.2.2.3 RELAY PANEL - MODEL HC-130H/N/P, WC-130H

ON AIRCRAFT MODELS HC-130H/N/P AND WC-130H, THE MLS RELAY PANEL IS MOUNTED ABOVE THE RADIO/WEATHER OPERATORS STATION. THE WEIGHT & ORIENTATION ARE IDENTICAL TO THAT OF THE RELAY PANEL USED FOR C-130E/H/B MODELS (SECTION 4.2.2.1). THEREFORE, THE SAME ULTIMATE AND WORST CASE LOADS WILL APPLY. THE ONLY DIFFERENCE IS THAT THIS INSTALLATION WILL USE ONLY SIX (6) SCREWS TO MOUNT THE RELAY PANEL TO THE AIRCRAFT. ONLY THESE SCREWS WILL BE CHECKED HERE.

• CHECK SCREWS ATTACHING CHANNELS TO AIRCRAFT

SCREWS = NAS 623-2 (8 REQD)

$P_{TA} = 1740$ LBS

$P_{SA} = 1160$ LBS

WORST CASE LOADING = FWD $P_{FWD} = 240$ LBS

RELAY PANEL IS MOUNTED IN MIRROR-IMAGE OF THAT OF 4.2.2.1 (CHANNELS ARE ROTATED 180°). ALL THIS WILL DO IS EFFECTIVELY SWITCH THE SIGN OF LOADS CALCULATED IN THAT SECTION. THEREFORE:

$P_T = 325.3$ LBS

ASSUMING 3 SCREWS HOLD IN TENSION, 3 IN SHEAR

$$R_T = 325.3/(3)(1740) = .062$$

$$R_S = 240/(3)(1160) = .069$$

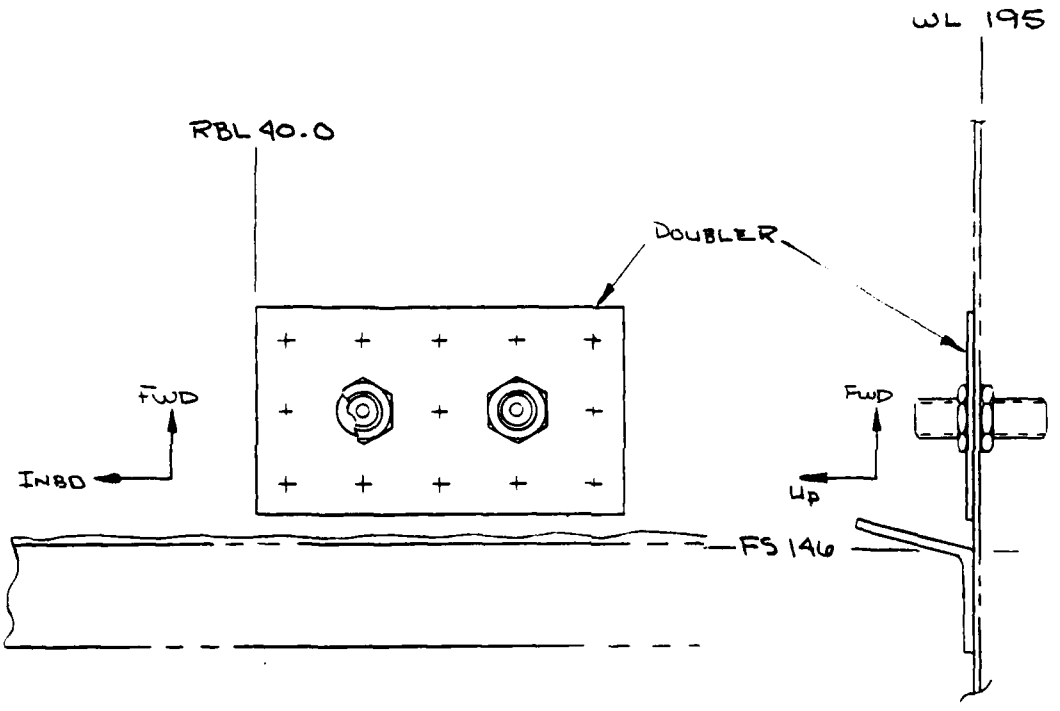
$$MS = \frac{1}{\left[(.062)^2 + (.069)^2\right]^{1/2}} - 1 \Rightarrow \underline{+9.8}$$

4.2.2.3 RELAY PANEL - Models HC-130H/N/P, WC-130E/H

Analysis not complete on these installations. Preliminary analysis indicates that all Margins of Safety are positive and >0.25.

4.2.3 FRONT PRESSURE FEED-THRU

THE TWO FRONT ANTENNAS ARE MOUNTED IN AN UN-PRESSURIZED AREA. THE CABLE MUST BE ROUTED THRU A BULKHEAD INTO THE CARGO COMPARTMENT, WHICH IS PRESSURIZED. TWO (2) BULKHEAD FEED-THRU CONNECTORS ARE USED, AND A DOUBLER IS ADDED FOR STRENGTH.



- WORST CASE LOADING

THE DOUBLER IS PLACED HORIZONTALLY ON THE PRESSURIZED SIDE OF THE SKIN. THE MAX. LOAD ON THE DOUBLER WILL BE THE PRESSURE DIFFERENTIAL. THEREFORE

$$P_{ULT} = 14.7 \text{ psi}$$

4.2.3 (FRONT PRESSURE FEED THRU)

- CHECK SKIN AND DOUBLER SHEAR CAPACITY.

SKIN : 2024-T4 IAW QQ-A-250/5 .080 STK

F_{TU} = 61 KSI
F_{SU} = 38 KSI

DOUBLER: 2024-T3 IAW QQ-A-250/4 .063 STK

F_{TU} = 64 KSI
F_{SU} = 39 KSI

SHEAR LOAD CAPACITY OF MATL REMOVED.

TO ACCOMODATE THE TWO PRESSURE FEED-THRUS, SKIN MAT'L MUST BE REMOVED IN THE FORM OF TWO (2) Ø.51 HOLES

AREA LOST = 2(.5)(.080) = .08 in^2
SHEAR LOST = (.08)(38) = 3.04 KIPS

SHEAR LOAD CAPACITY OF ADDED DOUBLER

AREA ADDED = (.063)(3.0-1.0) = .13
SHEAR ADDED = (.13)(39) = 5.07 KIPS

$$MS = \frac{5.07}{3.04} - 1 \Rightarrow +.67$$

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4.2.3 (FRONT PRESSURE FEED THRU)

• CHECK RIVETS ATTACHING DOUBLER TO AIRCRAFT

RIVETS = MS20470AD4 (13 REQD)

P_{SA} = 340 LBS / RIVET

RIVETS MUST HAVE SHEAR CAPACITY GREATER THAN THAT OF MATL REMOVED

$$MS = \frac{340(13)}{3040} - 1 \Rightarrow \underline{+.45}$$

• CHECK PRESSURE LOAD ON SKIN AT CONNECTORS

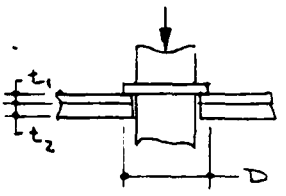
THE PRESSURE DIFFERENTIAL WILL ACT OVER THE AREA OF THE CONNECTOR. ASSUMING THIS AREA TO BE THE LARGEST AT THE BASE (AT THE HEX FITTING)

$$A_P \approx \frac{\pi}{4}(.56)^2 \approx .25 \text{ in}^2$$

THE MAX. LOAD ON THE CONNECTOR DUE TO PRESSURE IS THEN

$$F_P = (.25 \text{ in}^2)(14.7 \text{ psi}) = 3.7 \text{ lbs}$$

CALCULATE THE SHEAR AREA.



$$A_S = \pi D(t_1 + t_2)$$
$$= \pi(.56)(.063 + .08) = .25$$

SHEAR STRESS

$$\tau = \frac{3.7}{.25} = 14.7 \text{ psi}$$

$$MS = \frac{38000}{14.7} \Rightarrow \underline{+ \text{VERY HIGH}}$$

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